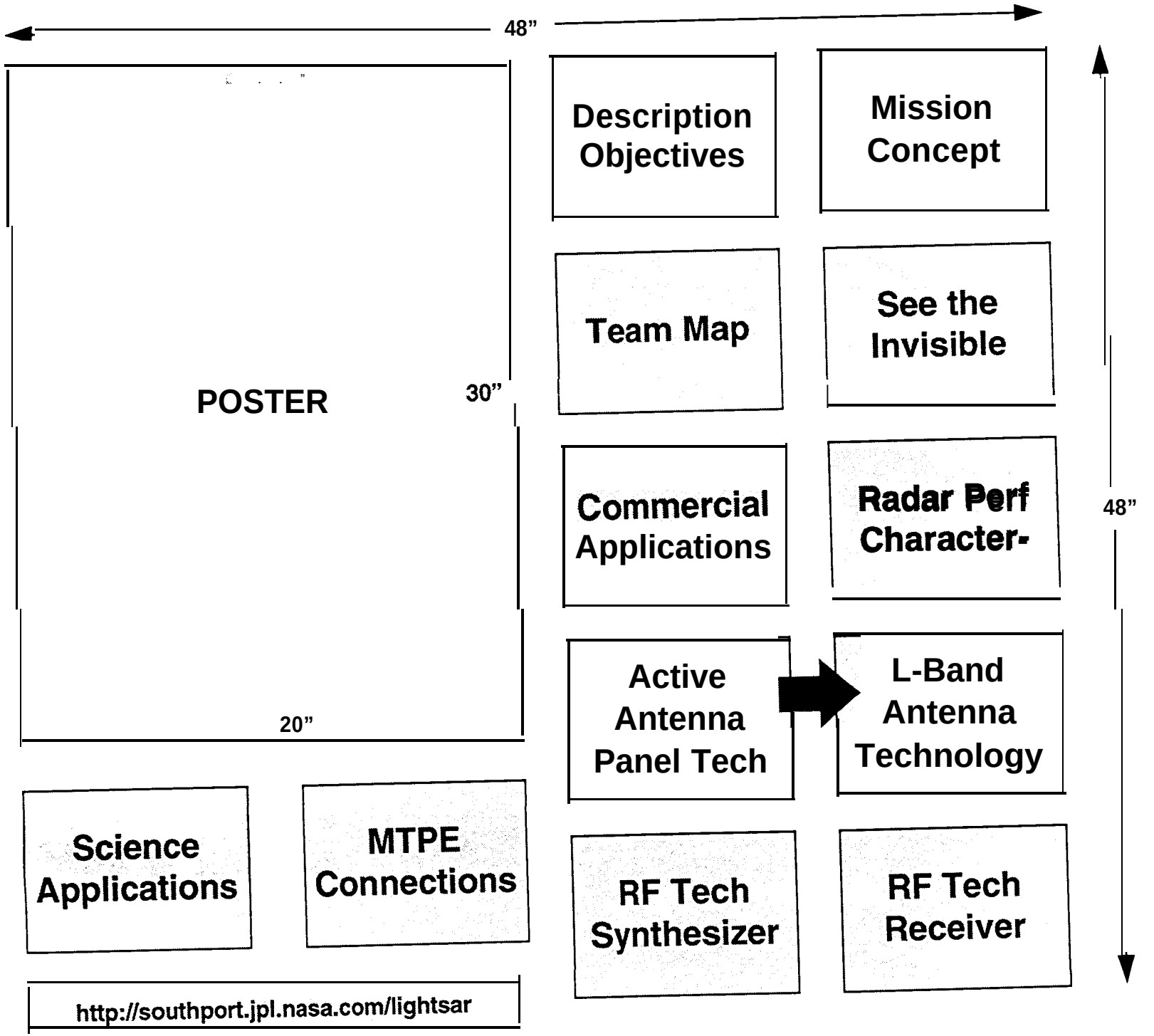
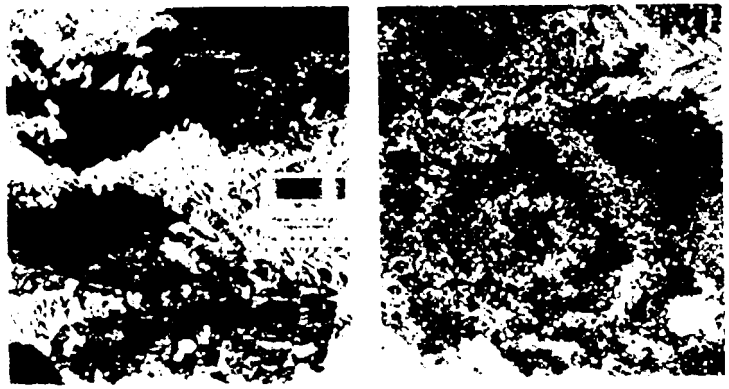

48”
POSTER
30”
20”
Description Objectives
Mission Concept
Team Map
See the Invisible
Commercial Applications
Radar Perf Character-
Active Antenna Panel Tech
L-Band Antenna Technology
RF Tech Synthesizer
RF Tech Receiver
48”
Science Applications
MTPE Connections
http://southport.jpl.nasa.com/lightsar

# JPL L G[illegible]SAR SC[illegible]CE APPL CAT ONS

## Natural Hazards

Seismic Deformation

Volcanic Deformation



Surface Deformation Mapping

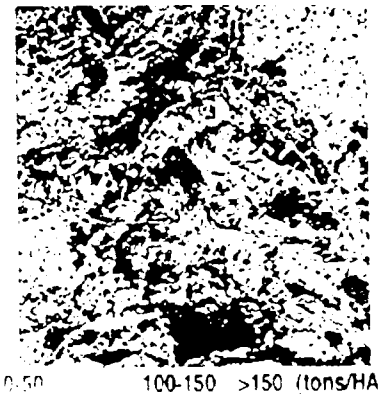
## Ice Mass Ba ance

Glaciers

Ice Flow Velocity Mapping

## Carbon Cycle

Forest Regrowth



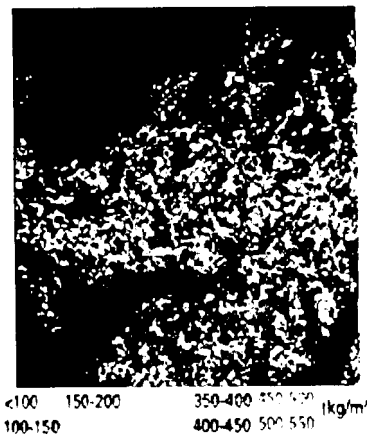

Biomass Mapping

## Hydrolo[illegible]c Cycle

Soil Hydrology


Soi Moisture Mapping

Snow Properties




Snow Density Mapping

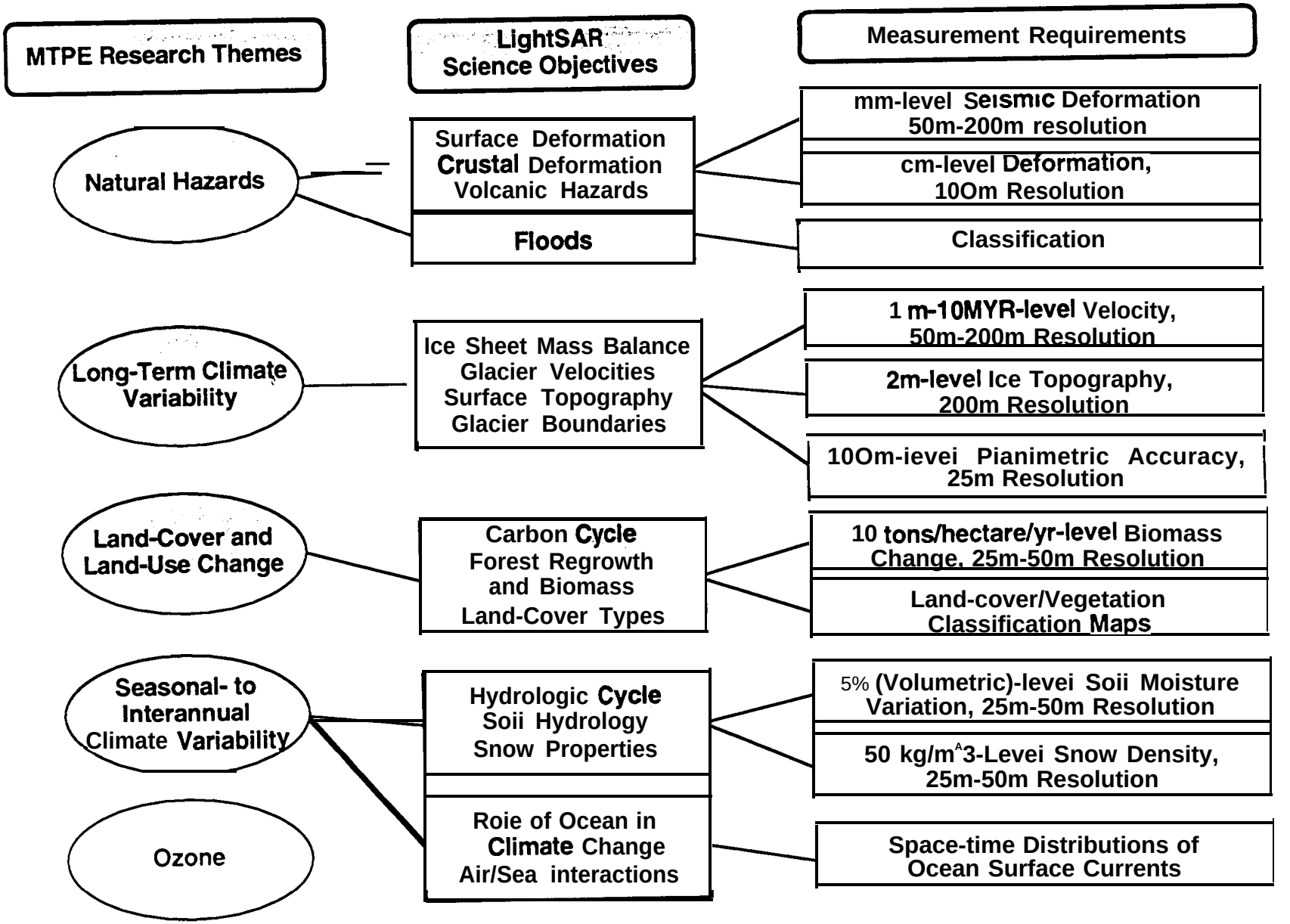
## Role of Oceans

Mesoscale Ocean Circulation

Ocean Wave Dynamics

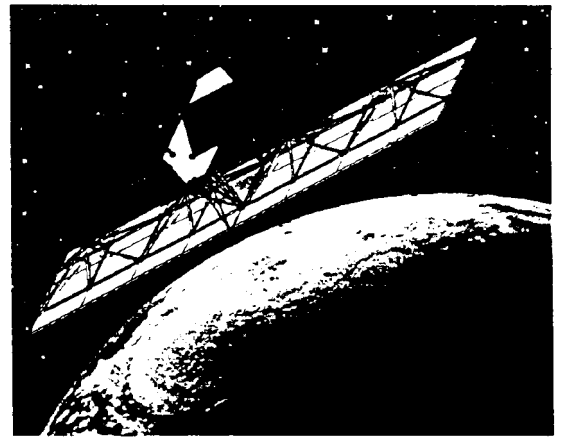
JPL

# LIGHTSAR SCIENCE ADVANCES NASA'S MTPE RESEARCH THEMES



# JPL LIGHTSAR DESCRIPTION & OBJECTIVES

**LightSAR** is a low-cost, lightweight, high-performance, Earth-imaging Synthetic Aperture Radar (SAR) mission that will:



Produce important< . . . and exciting data for Earth science and civilian SAR applications

Develop markets “”” and provide valuable data for **commercial** applications

Validate advanced **technologies** that will significantly reduce the cost and enhance the performance of SAR missions

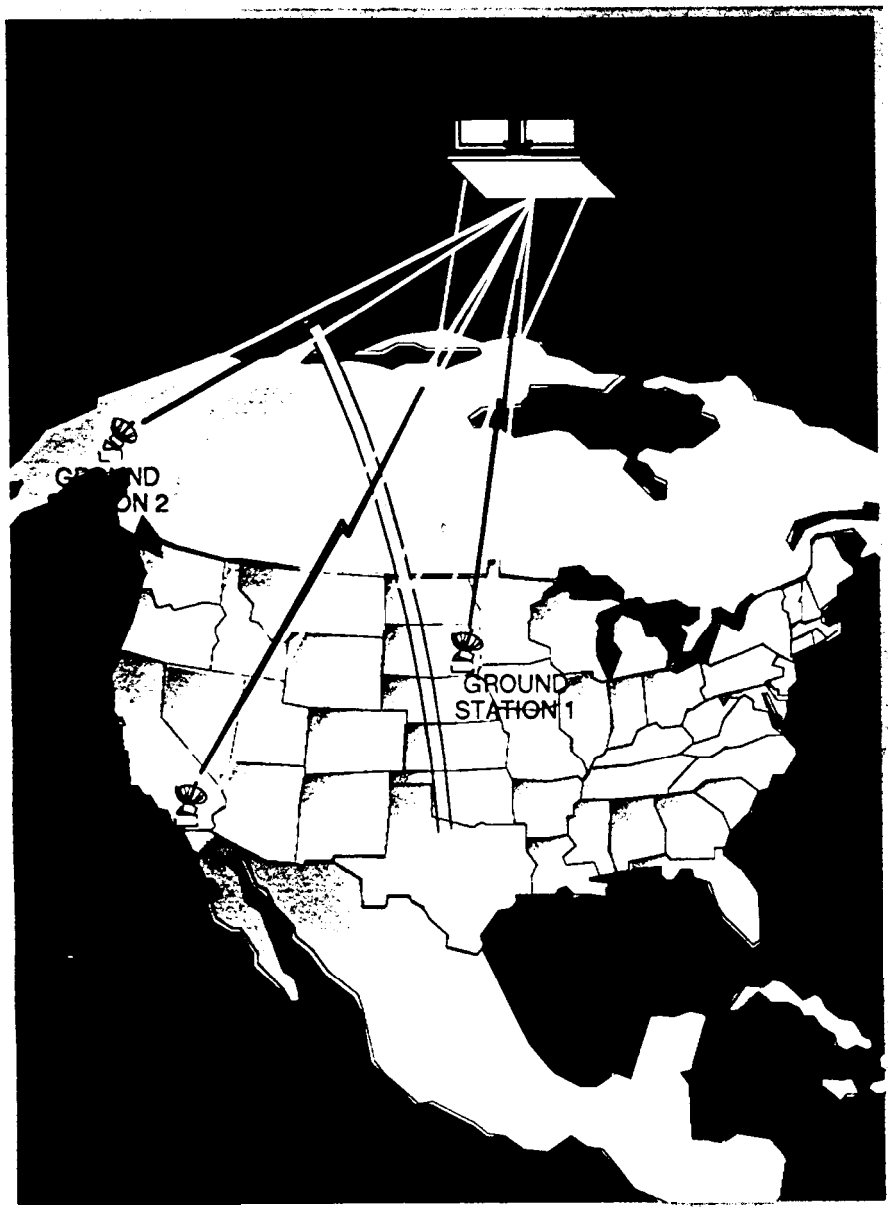
**Launch:**

**Technology Validation Phase:**

**Mission Duration:**

JPL

# LIGHTSAR MISSION CONCEPT




Synthetic Aperture Radar Payload:
- L-band (1.26 GHz) < 250 kg high-performance radar instrument for multi-resolution, multiple-swath, science objectives
- X or C band radar instrument for 1 m high-resolution commercial remote sensing

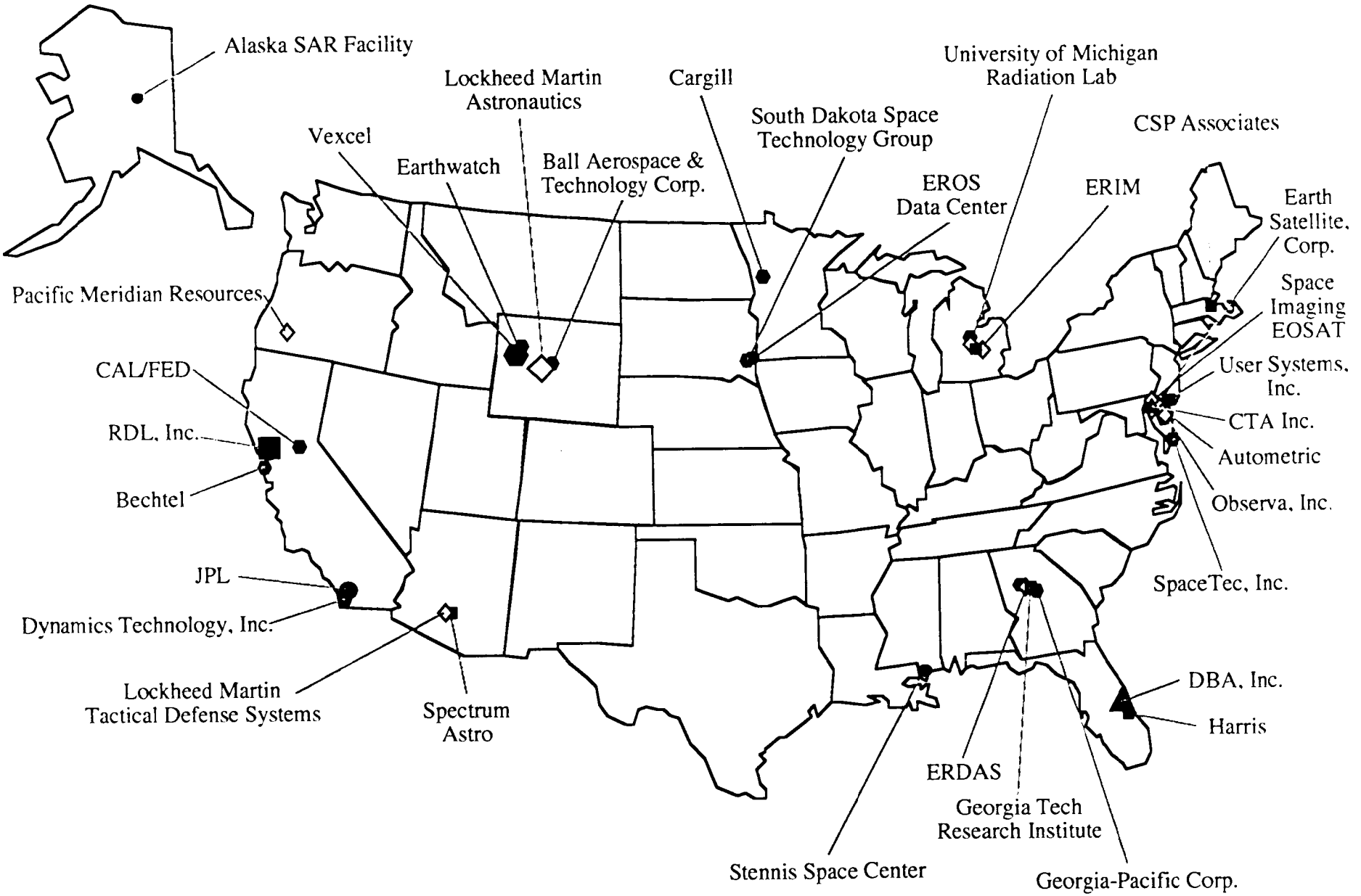
- Launch vehicle: Taurus XL or LMLV-2 class
  - Total flight system mass < 960 kg
  - Orbit altitude 600 km
  - 10-day repeat orbit
  - Global coverage in all modes, with visibility of most locations on Earth every day

- Downlink opportunities:
  - Several per day to numerous sites such as Alaska SAR Facility, EROS Data Center, commercial and university ground stations

- Innovative government-industry teaming, with:
  - Industry cost share investment
  - Industry operates mission for 5 or more years
  - Command/ control from existing commercial satellite operations center
  - Data purchase by government

JPL

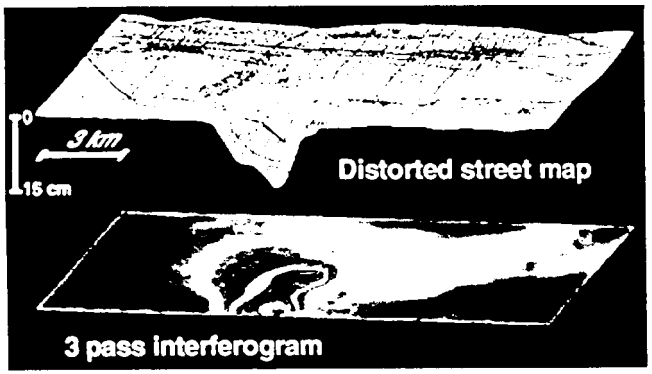
# GHTSAR TEAM



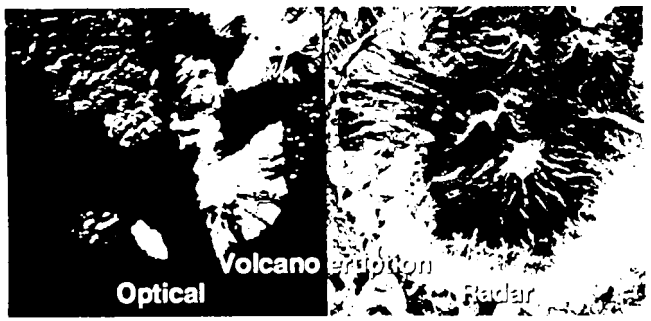
JPL

# LIGHTSAR
# W LL SEE THE INV SIBLE

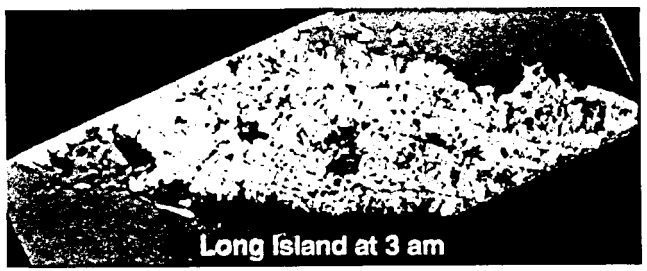
See minute surface changes over wide areas




See through smoke




See in the dark




See below the surface


See through clouds / rain

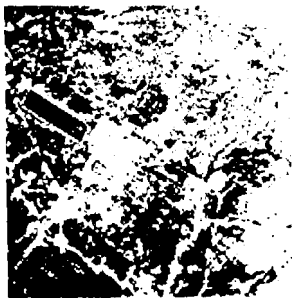

*Radar waves penetrate clouds and, under certain conditions, vegetation canopies, ice, and very dry sand or soil, making it possible to explore areas not accessible with other remote sensing techniques.*

# LIGHTSAR COMMERCIAL APPLICATIONS

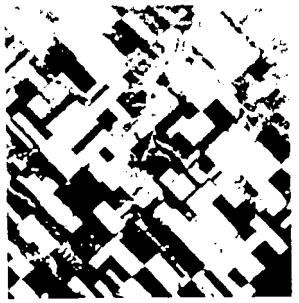
## ALL-WEATHER, DAY-NIGHT, REMOTE SENSING

Mapping / Cartography

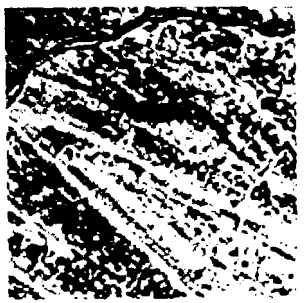
Surveillance



Agricultural
Crop Monitoring

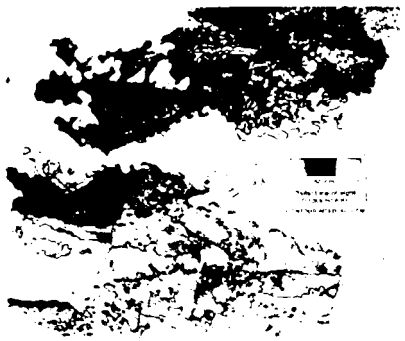


Resource Exploration
and Management

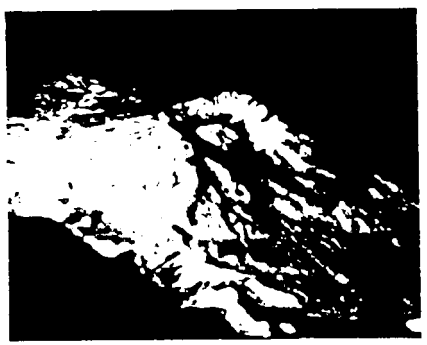


Urban Planning

Earthquakes



Volcanoes



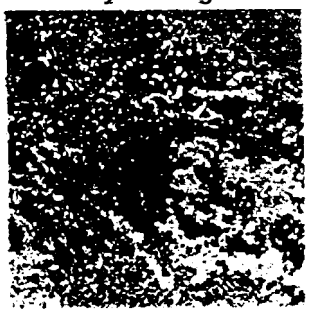
Environmental Monitoring

Oil Spills

Floods

Coastal Zones

Forestry Management




Wetlands, Fisheries

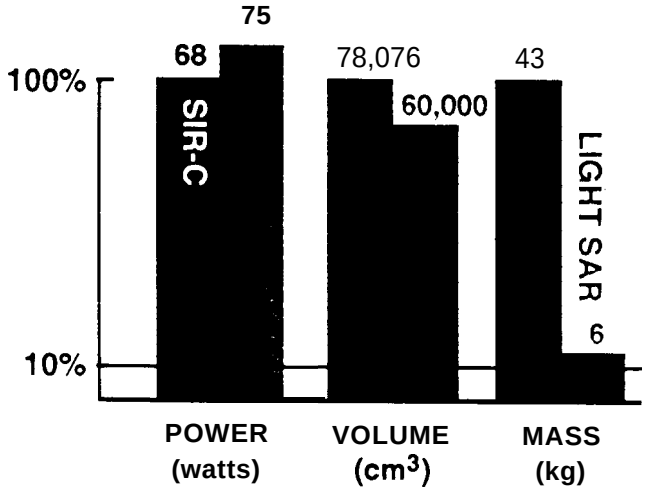
JPL

# LIGHTSAR
# RADAR PERFORMANCE CHARACTERISTICS

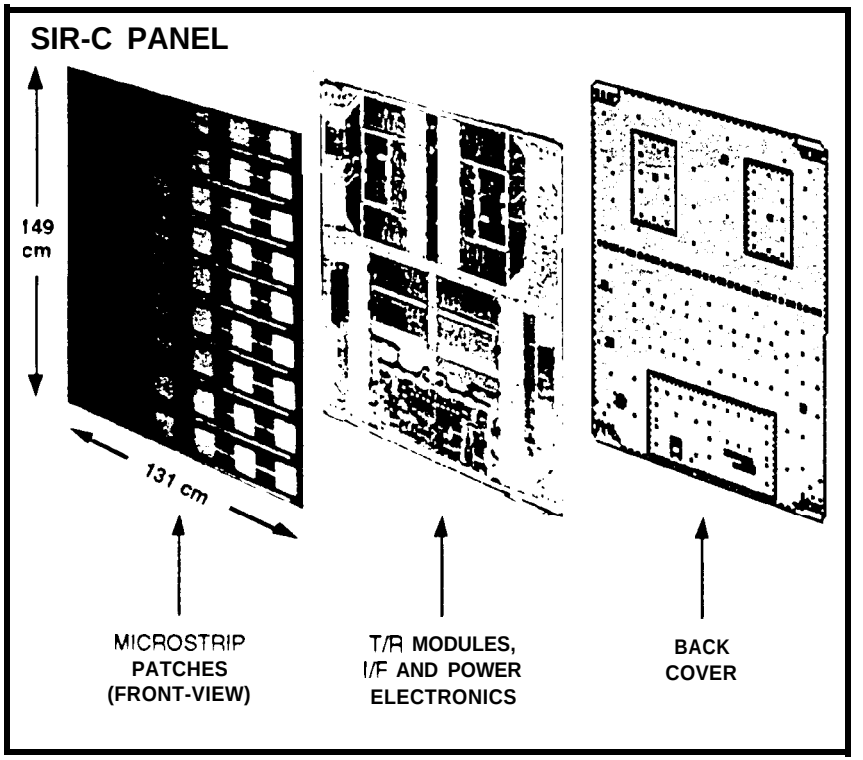
- **Frequency:** L-Band (~ 1.2575GHz center frequency)
  (X-band or C-band are also being considered)
- **Bandwidth:** up to 80 MHz
- **Antenna size:** 2.9 meters (elevation) x 10.8 meters (azimuth)
- **Peak Power:** 8 kW
- **Radar mass:** < 250 kg total
- **Operating Modes**
  - Multiple resolutions swath
  - Multi-polarization
  - Repeat pass interferometer

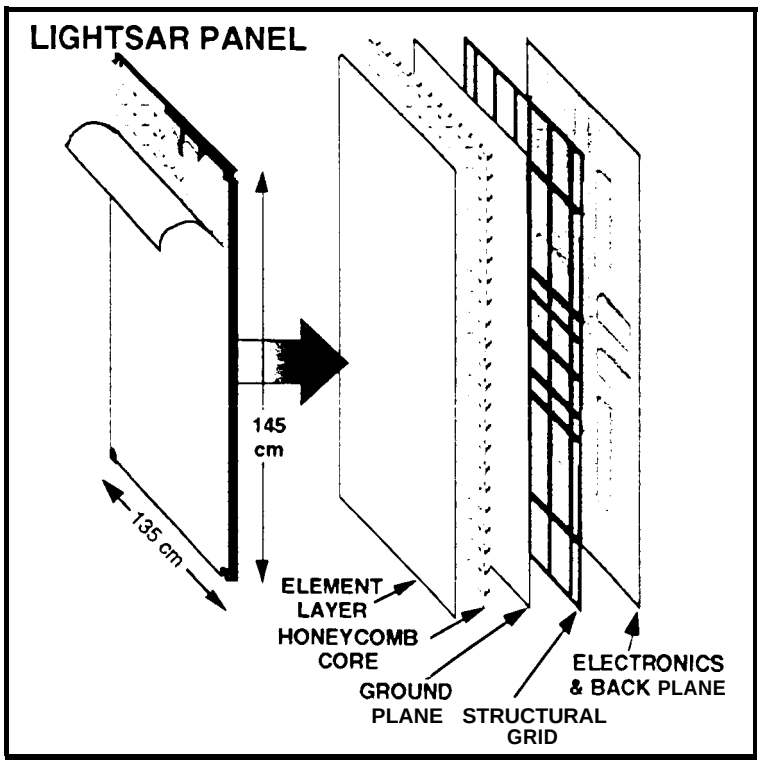
| *Radar Operation* | High Resolution Spotlight | High Resolution Stripmap | Quad Polarization | Dual Polarization | Repeat-pass Interfer-ometer | ScanSAR |
|---|---|---|---|---|---|---|
| Resolution (m) | 3 | 6-10 | 25 | 25 | 25 | 100 |
| Swath (km) | 15x20 | 22 | 50 | 50 | 100 | 280 |
| Looks | 3 | 3 | 2 | 4 | 8 | 8 |
| Incidence Angle | 20-52° | 20-52° | 20-40° | 25-52° | 25-44° | 20-52° |
| Polarizations | HH orVV | HH or VV | HH, HV, VH, VV | HH,HV, or VV ,VH | HH or VV | HH, HV or VV, HH |
| Noise-eq. $\sigma^o$ (dB) | -23 | -29 | -32 | -29 | -27 | -30 |
| Data Rate (Mbps) | 150 | 150 | 120 | 80 | 105 | 40 |

# LIGHTSAR
# ACTIVE ANTENNA PANEL TECHNOLOGY



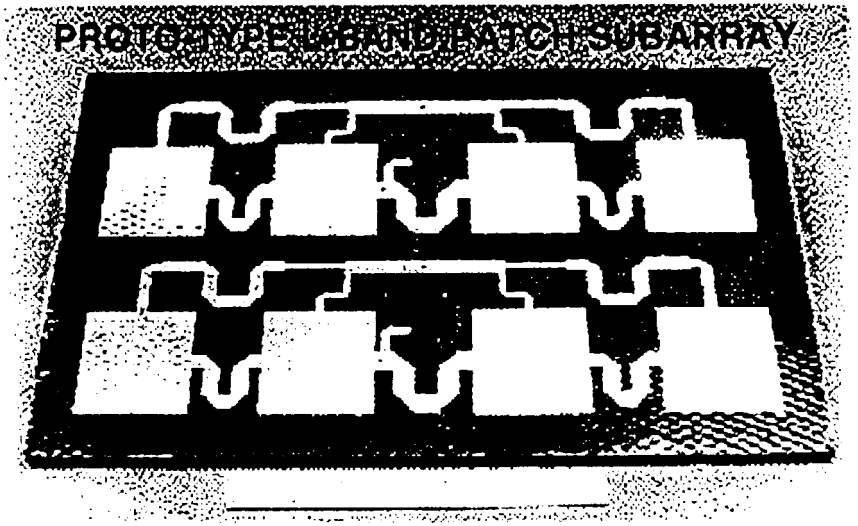

- 85 % reduction in mass for similar power and size
- Ultra-lightweight panels with distributed miniature T/Rs and phase shifters (MMIC / SSPA) for electronic beam steering
- Wide bandwidth capability (80MHz)

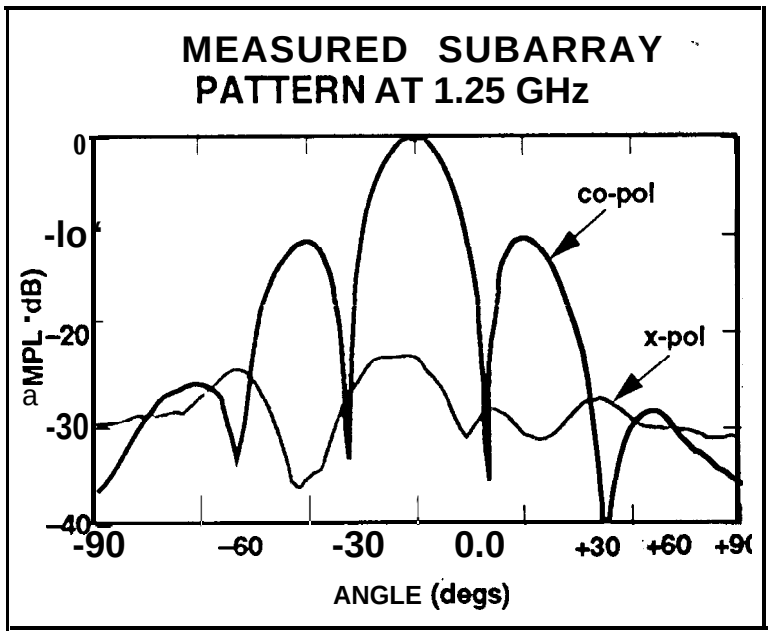


JPL

# LIGHTSAR
# L-BAND ANTENNA TECHNOLOGY




## CHARACTERISTICS

**FACE SHEET: 5 µM COPPER on 2-roil KAPTON**

**SUBSTRATE: 1.27 cm thick NOMEX HONEYCOMB**

**SUBARRAY MASS: 0.4 Kg**

**SUBARRAY AREA: 68 cm x 40 cm**

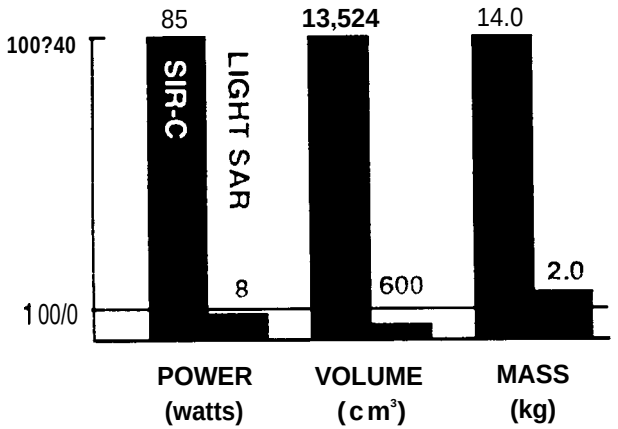
**MEASURED GAIN: 16.5 dBi**

**MEASURED EFFICIENCY: 80%**

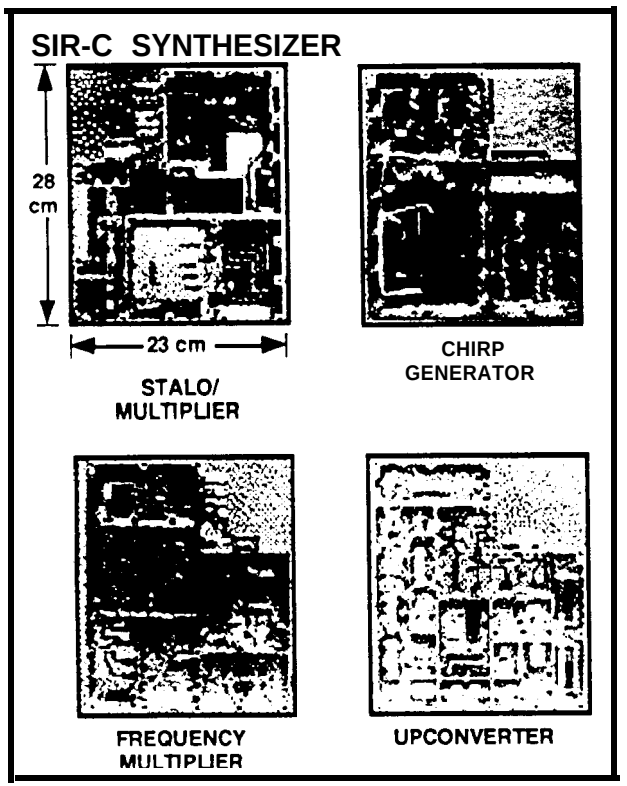
**BANDWIDTH: 80 MHz**

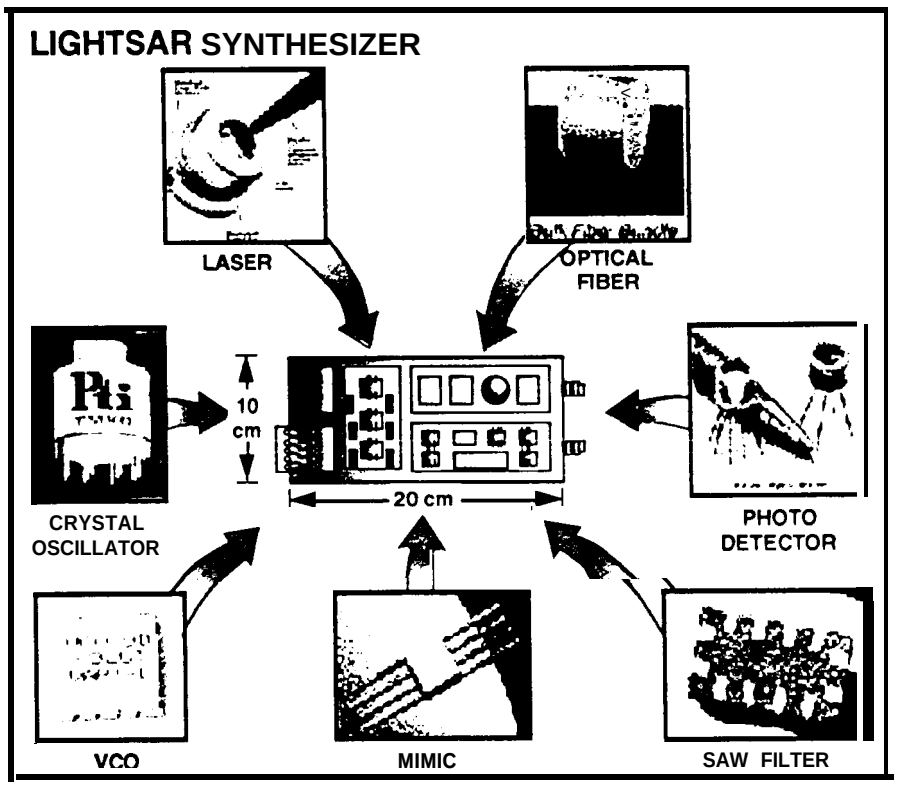
JPL

# LIGHTSAR
# RF ELECTRONICS TECHNOLOGY: SYNTHESIZER

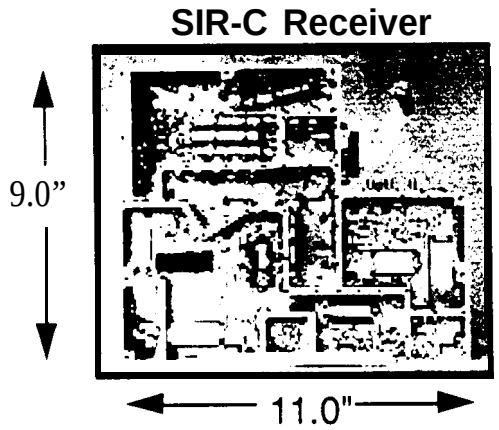


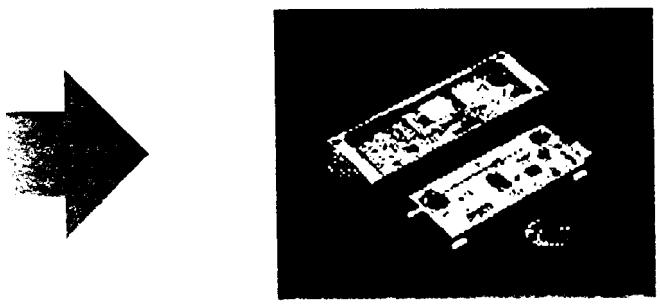

- Miniature low-power opto-electrical direct RF frequency synthesizer
- Multiple bandwidth selection
- High-efficiency power converters

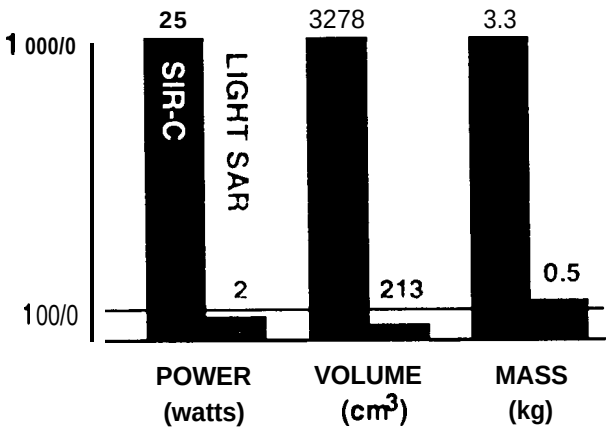


# LIGHTSAR
# RF ELECTRONICS TECHNOLOGY: RECEIVER






- MMIC Components
- Low Noise Amplifier
- Surface Acoustic Wave Filter
- Bandwidth Selectable
- Variable Gain Control
- High Dynamic Range
- MCM Packaging

***Check our web site to find out more***

**http://southport.jpl.nasa.gov/lightsar**

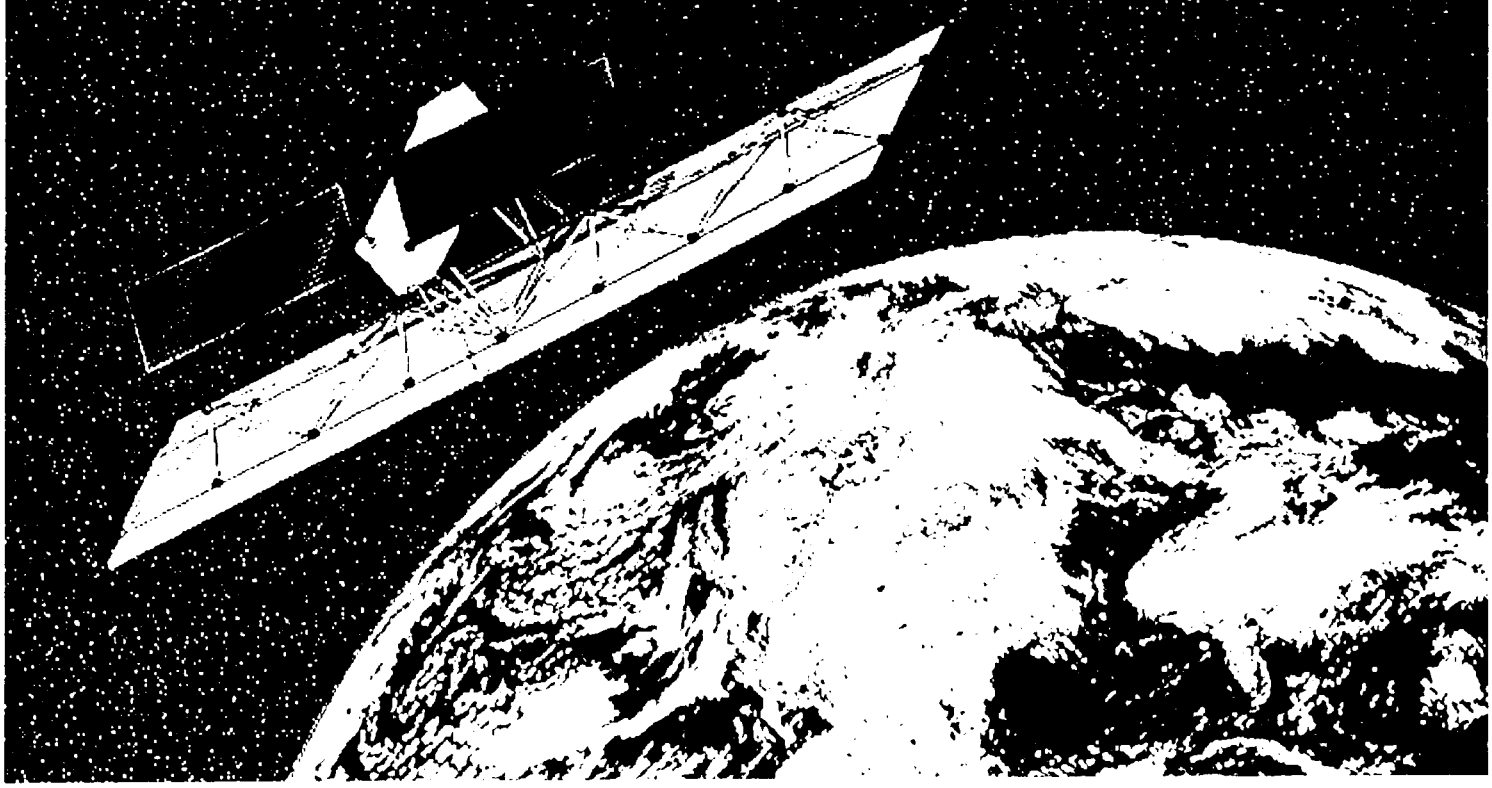
# LightSAR

From its vantage point in space, LightSAR will reveal Earth's hidden secrets.

Using imaging radar, with its unique capability to see through clouds, rain, and smoke, in the dark, and even below the surface, LightSAR will observe the changing conditions on Earth as they occur.

With LightSAR's ability to see almost everywhere on Earth at least once a day, it will continuously measure changes from earthquakes, volcanoes, and floods, on a global scale.

LightSAR's unprecedented capabilities will open new markets in commercial remote sensing, while helping us understand our changing world.



LightSAR is a proposed free-flying, Earth-observing, lightweight, synthetic aperture radar (SAR) mission. It is part of NASA's long term investment in the development and prosperous use of imaging radar science and technology in the public and private sector. Past spaceborne radar missions have established the vast potential of imaging radar for expanding scientific knowledge of the Earth and planets. LightSAR is an affordable leap forward that will deliver exciting Earth *science* data, demonstrate valuable new technologies, and lead the next level of expansion for the U.S. commercial remote sensing industry.

LightSAR's all-weather, day-night remote sensing capability, and visibility of almost everywhere on Earth each day, will result in numerous scientifically valuable and commercially lucrative applications. For example, LightSAR has the unique capability to continuously monitor minute changes in the Earth's surface (to the millimeter level), which can lead to improved understanding of natural hazards such as earthquakes and volcanoes, while supporting emergency management efforts. Studying the movements and changing size of glaciers and ice floes will support long-term climate variability studies. 'I'he forest regrowth and biomass mapping data produced by LightSAR will support land cover and land use change studies. LightSAR's 1 to 3 meter high-resolution capability has significant commercial potential for topographic mapping, surveillance, crop monitoring, and land management, planning and development.

JPL is leading the development of LightSAR for NASA, in collaboration with NASA Stennis Space Center and four industry teams, to establish complementary ways of jointly fulfilling strategic science and commercial remote sensing needs. A major goal is to design, develop and launch by the year 2002, a high-performance SAR spacecraft for about a factor of 4 lower cost than that of previous free-flying SAR missions (including launch services). These cost reductions will be achieved by combining the use of advanced technologies, commercial spacecraft, launch vehicle, and operations practices, services and infrastructures, "faster, better, cheaper" management, and an innovative government-industry partnership approach. Technology developments incorporated in the SAR payload include advanced microelectronics and lightweight materials that enable significant performance enhancements relative to previous SAR instruments, at a total payload mass of under 250 kg. This low mass enables the LightSAR spacecraft to be launched on a small launch vehicle such as a Taurus XI. or LMLV-2.

In November 1997, the four independent industry studies will report their recommendations on innovative approaches to government-industry teaming, and concepts for maximizing commercial investment in LightSAR. Information will encompass market analyses, pilot applications projects, development of operational scenarios and business plans, space and ground segment requirements, cost estimates, and potential industry cost share commitments for the follow-on phases, as well as detailed approaches and options for LightSAR implementation, including mission architecture, space and ground segment designs, radar instrument specifications, launch services, operational scenarios, and development and operations cost estimates. NASA will use this information to plan the next phases of the LightSAR project.